

Notes on a Collection of Bats from Central America, with the Third Record for *Cyttarops alecto* Thomas

ANDREW STARRETT & LUIS DE LA TORRE

Department of Biology, University of Southern California, Los Angeles 7, California¹
and College of Pharmacy, University of Illinois, Chicago, Illinois

(Text-figures 1-10)

THIS PAPER presents records and life history data from three collections of bats from Central America: 48 specimens taken by the senior author, together with Priscilla Starrett and Thomas M. Uzzell, Jr., in the summer of 1957, during a three-month trip undertaken primarily for the purpose of collecting herpetological specimens; four bats collected by Arnold Menke and Fred S. Truxal, also in the summer of 1957, while engaged in collecting insects (Los Angeles County Museum Costa Rican Entomological Expedition); and 22 specimens collected in Costa Rica by members of the 1939 Allan Hancock Expedition aboard the "Velero III" (Fraser, 1943a, 1943b). All except eight of the bats were preserved as alcoholic specimens and all are now in the mammal collection of the Los Angeles County Museum. All of them have in common the fact that they were collected opportunistically, during the course of other types of investigation and collecting. The significance and interest of several of these specimens indicate the possible importance of even one or two bats which might be collected by any person carrying on non-chiropteran studies in the Neotropics, not to mention the potential which could be realized by a planned project of investigation of the bats of a neotropical region or country.

Abbreviations and locality names used in reference to specimens collected by the senior author and companions in 1957 are:

I.I.C.A.=Instituto Interamericano de Ciencias Agrícolas, under the Organization of American States, with headquarters and main Costa Rican facilities in Turrialba, Costa Rica.

I.T.I.C.=Instituto Tropical de Investigaciones Científicas, University of El Salvador, San Salvador.

S.T.I.C.A.=Servicio Técnico Interamericano de Cooperación Agrícola, a cooperative organization involving the United States and Costa Rican governments.

La Cinchona=S.T.I.C.A. quinine plantation near Varablanca, on the northeast slope of Volcán Poás.

Los Diamantes=S.T.I.C.A. experimental rubber station on the old rail line, near Guápiles, Costa Rica.

El Hogar Bíblico=Methodist children's home on the southwest slope of Volcán Barba, located at San José de la Montaña, several kilometers from the village of Barba, Costa Rica.

La Hulera=Formerly a S.T.I.C.A. experimental rubber station in Turrialba, Costa Rica, now a part of the I.I.C.A.

ACKNOWLEDGMENTS

During the course of the 1957 trip by the senior author and companions, a number of people were most gracious in their contributions to the success of our venture. Special appreciation is due here to some of these for their parts in making the collection of bats possible: Dr. Arístides Palacios, Director, and Sra. Aida Cabezas O., Administrative Assistant, I.T.I.C., San Salvador; Sr. Alejandro Salazar, our host at Hacienda La Cumpilda, Matagalpa, Nicaragua; Sr. Gerardo Budowski, Renewable Resources Department, I.I.C.A., Turrialba; Sr. Edilberto Camacho, La Hulera, Turrialba; Mr. and Mrs. Robert Bartlett, Los Diamantes; and Mr. and Mrs. William Brown, Hogar Bíblico, San José de la Montaña.

Parasite identifications were made by Richard S. Casebeer, University of Southern California

¹Present address: Department of Biology, Northeastern University, Boston 15, Massachusetts.

(Arachnida), Walter E. Martin, University of Southern California (endoparasites) and Rupert L. Wenzel, Chicago Natural History Museum (Diptera). Fred S. Truxal, Los Angeles County Museum, identified certain insect remains from gut contents.

The illustrations were prepared by Miss Alice E. Boatright, Scientific Illustrator, Department of Zoology, University of Illinois. Miss LaVerne Curry, Alhambra Medical Center, Alhambra, California, prepared the serial sections of testes.

We wish also to thank Kenneth E. Stager and Charles A. McLaughlin for permission to include the Menke-Truxal specimens in this report.

All specimens are adult and fluid-preserved unless otherwise noted. All measurements are given in millimeters.

SYSTEMATIC LIST

Family EMBALLONURIDAE

Subfamily Emballonurinae

Saccopteryx bilineata (Temminck)

Urocryptus bilineatus Temminck, 1838-39, Tidjschr. natuurl. Gesch. Phys., 5:33—Surinam.

S. bilineata centralis Thomas, 1904, Ann. Mag. Nat. Hist., ser. 7, 13:251—Teapa, Tabasco, Mexico.

Specimens.—Costa Rica: Prov. Puntarenas, Golfito; 1 female.

Reproduction.—This specimen showed no macroscopic evidence of reproductive activity. The wing sacs were not developed and lacked apparent glandular activity.

Food.—The esophagus and stomach were distended with finely chewed insect remains; several boluses of insect remains were also found in the lower small intestine.

Parasites.—Chiggers (larval Trombiculidae) were found embedded in the ears and at the base of the interfemoral membrane on the dorsal surface.

Remarks.—This specimen was captured in an insect net by Menke and Truxal as it flew back and forth in the breezeway of a building of the United Fruit Company facility, on the evening of July 17, 1957.

Measurement.—Forearm, 46.8.

Peropteryx kappleri Peters

Peropteryx kappleri Peters, 1867, Monatsb. Preuss. Akad. Wiss. Berlin, 1867: 473—Surinam.

Specimens.—Costa Rica: Prov. Puntarenas, "Gulf of Dulce" (Golfo Dulce), near Matapalo Head, Osa Peninsula (Fraser, 1943a: 160), at

Station 940, Lat. 8° 24' 30" N., Long. 83° 17' 05" W. (Fraser, 1943b: 332, 407, Chart 1017); 10 males (3 skin and skull, 1 skeleton only), 12 females (4 skin and skull).

Reproduction.—Nine of the 12 females contained embryos; those in alcohol all contained male fetuses ranging from 19.0 to 22.3 mm. crown-rump length. The smallest fetuses lacked fur; the others showed fur dorsally and had hairs beginning to erupt in other regions. The testes of the fluid-preserved males were abdominal or inguinal, measured 1.9-2.5 × 2.6-3.1 mm. and showed activity ranging from early spermatogenesis with little sperm in the epididymides to active spermatogenesis with large amounts of sperm in the tubules and epididymides. The wing sacs of the males were well developed, with openings 5.5 mm. in length from the leading edge of the antebrachial membrane, and showed evidence of glandular activity. The sacs of the females were the same length as those of the males, but without any apparent glandular activity.

Food.—The intestines contained small amounts of finely chewed insect remains as well as small boluses containing bat hairs (presumably from the animals themselves).

Remarks.—These bats were collected above the high water line in a cave in "The large basaltic boulders near Matapalo Head" (Fraser, 1943a: 160), March 26, 1939.

Measurements.—Forearm, average for nine males, 45.6 (45.1-46.9), for 12 females, 49.5 (47.9-50.6); greatest length of skull, four males 15.3-16.1, four females, 15.9-16.1.

Subfamily Diclidurinae

Cyttarops alecto Thomas (Figures 1-10)

Cyttarops alecto Thomas, 1913, Ann. Mag. Nat. Hist., ser. 8, 11:134—Mocajutube, near Pará, Brazil.

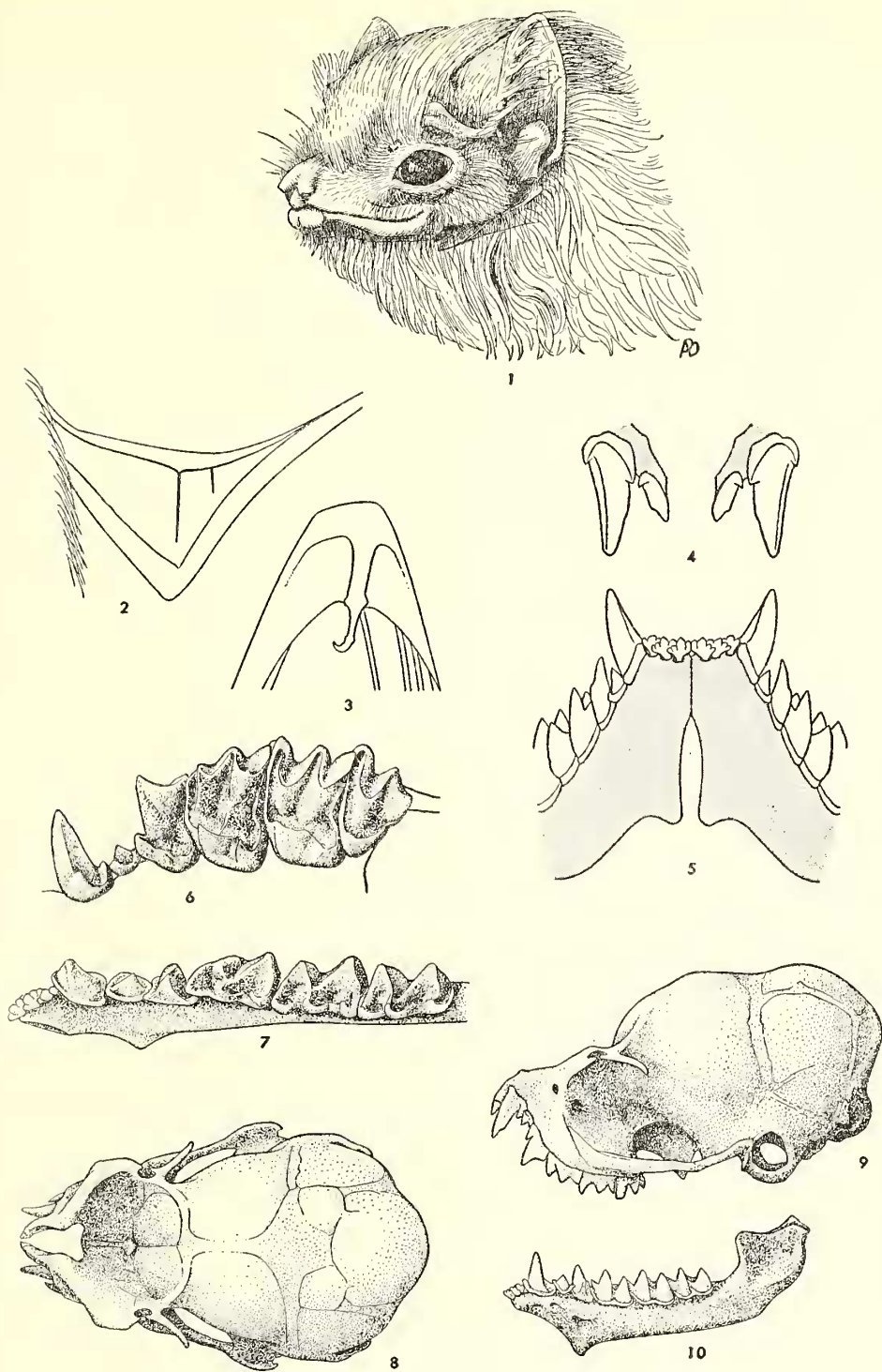
Specimens.—Costa Rica: Prov. Limón, Los Diamantes, 300 m. elevation; 1 male, 2 females.

Reproduction.—Neither female showed macroscopic signs of reproductive activity, either in condition of the uterus or in the appearance of the mammae. The male had small abdominal testes, 1.0 × 1.7 mm., which showed some spermatogenesis but no sperms in the tubules or epididymides.

Food.—The stomachs and intestines of these specimens contained a mixture of finely chewed insect remains.

Parasites.—No parasites were found in or on any of these specimens.

Remarks.—The specimens were given to the senior author by Mr. Robert Bartlett, director of the S.T.I.C.A. rubber station at Los Diamantes.



TEXT-FIGS. 1-10. *Cyttarops alecto* Thomas. 1. Head, $\times 3$. 2. Antebrachial membrane, $\times 1\frac{1}{4}$. 3. Detail of thumb, $\times 3$. 4. Upper incisors and canines, \times approx. 20. 5. Anterior view of mandibles, \times approx. 20. 6. Detail of upper tooth row, \times approx. 12. 7. Detail of lower tooth row, \times approx. 9. 8. Dorsal view of skull, \times approx. 5. 9. Lateral view of skull, \times approx. 5. 10. Lateral view of left mandible, \times approx. 5.

They were brought to him on approximately August 1, 1957, by workers who had taken them from a group of bats (total number unknown) in an ornamental coco palm.

Nothing has been published concerning this bat since the original description of the genus and species in 1913. At that time (Thomas, 1913), two specimens were known: the type from Pará, Brazil, and a second specimen from Mazaruni River, British Guiana. The three specimens here recorded thus provide the third record of this bat and extend its known range northward into Central America.

Superficially, *Cyttarops* is similar in size and general appearance to *Peropteryx* or *Balantiopteryx*. However, closer examination of the skull and external features bears out Thomas' (1913) characterization of this bat as a relatively unspecialized diclidurine, intermediate in structure between *Diclidurus* and other New World emballonurids. Externally, *Cyttarops* differs from all American members of subfamily Emballonurinae in its low rounded ears (Text-fig. 1) and its broad antibrachial membrane which extends to the base of the distal phalanx of the thumb (Text-fig. 3). There is no antibrachial sac in either sex, nor is there any indication of one (Text-fig. 2). The interfemoral membrane is well developed and is supported from each ankle by a long (± 16 mm.), strong calcar. As in other emballonurids, the tail is attached to the under surface of the membrane for most of its length until, near the middle of the membrane, it turns dorsad and appears on the dorsal surface as a "free tail" of about four or five millimeters in length. There are no special modifications of the interfemoral membrane in either sex such as are found in *Diclidurus*. The fur of *Cyttarops* is long and silky with the color above and below appearing as Thomas described it, "uniform dull smoky grey," almost black. Externally, *Cyttarops* can be distinguished from the species of *Diclidurus* by its small size, dark color and unspecialized interfemoral membrane.

The skull of *Cyttarops* (Text-figs. 8, 9) closely resembles that of *Diclidurus*, except in the smaller size of the former. It differs also in having a more extremely pronounced frontal cup and a relatively long (2.5 mm.) postorbital process. The dental formula is $1-1-2-3 \times 2 = 32$

teeth, as in other New World Emballonuridae. The upper incisor (Text-fig. 4) comprises a major cusp and a small lateral basal cusp; the major cusp has a terminal (medial) lobe and a slightly less well developed subterminal (lateral) lobe. The upper canine (Text-fig. 4) has two basal cusps, one anterolingual and the other postero-

labial in position. The shape and structure of the upper premolars and molars are shown in Text-fig. 6. The lower incisors are basically trilobed, with the lateral lobe of the first and second bipartite and of the posterior incisor simple. The lower canine has one anterior basal cusp and two posterior ones arising from the cingulum. The lower premolars and molars are shown in Text-fig. 7.

The features of the postcranial skeleton listed by Miller (1907:94-95) as characters of the subfamily Diclidurinae are seen in *Cyttarops*: the clavicle is expanded and the tibia is grooved longitudinally, although neither character is as well developed in *Cyttarops* as in *Diclidurus*.

Measurements.—Females (male damaged and not measured): forearm, 46.4, 47.2; metacarpal III, 44.3, 47.7; metacarpal IV, 36.2, 33.4; metacarpal V, 30.8, 33.5; (cranial measurements, largest female) greatest length of skull, 13.6; condylobasal length, 12.5; postorbital constriction, 3.8; zygomatic breadth, 8.0; mastoid breadth, 7.4; length of maxillary tooth row, 5.3; breadth across bases of upper canines, 2.4; maxillary breadth, including molars, 4.8; length of mandibular tooth row, 5.8; length of mandible, 9.9.

Family PHYLLOSTOMIDAE

Subfamily Phyllostominae

Phyllostomus hastatus panamensis J. A. Allen

Phyllostomus hastatus panamensis J. A. Allen, 1904, Bull. Amer. Mus. Nat. Hist., 20:233.—Boquerón, Chiriquí, Panamá.

Specimens.—Costa Rica: Prov. Cartago, Turrialba, I.I.C.A. 602 m. elev.; 2 males.

Reproduction.—The testes of one animal were just entering the inguinal canal and measured 2.9×4.6 mm., those of the other were scrotal in position and measured 3.9×8.1 mm. Sections of testes from both animals showed early spermatogenesis with many interstitial cells still present, but no sperm in the tubules or epididymides.

Food.—The stomachs and intestines of these animals contained fruit pulp, insect remains, a few tiny bird feathers and sand grains. One also had in its intestine a partially digested tick, *Amblyomma cajennense* (Fabr.) (Ixodidae).

Parasites.—Four batflies, *Trichobius mixtus* Curran (Streblidae), were taken from the fur of these animals, which were heavily infested with this parasite as well as with mites (Acarina: Spinturnicidae). The tick mentioned above, which has previously been recorded only from terrestrial hosts, raised the question as to whether it was plucked from the animal's own body or was ingested with some small mammal eaten by the

bat. Both bats had a small number of nematodes (*Histioglystus octacanthus* Lenta & Freitas) in the small intestine.

Remarks.—These animals were caught in a mist net set across a path in a platano plot behind the main building of the I.I.C.A., July 23 and 24, 1957. They were vicious and vociferous, producing a low, almost un-bat-like sound when being removed from the net.

Measurements.—Forearm, 90.6, 94.2; (cranial measurements for the larger male only) greatest length of skull, 40.8; condylobasal length, 37.0; palatilar length, 16.4; interorbital constriction, 7.6; zygomatic breadth, 22.0; mastoid breadth, 20.4; breadth of braincase, 15.1; length of maxillary tooth row, 14.5; maxillary breadth, including molars, 14.8; length of mandibular tooth row, 16.6; length of mandible, 27.8.

Subfamily Glossophaginae

Glossophaga soricina leachii (Gray)

Monophyllus leachii Gray, 1843, in *The Zoology of the Voyage of H.M.S. Sulphur* . . . Vol. 1, No. 1, Mammalia, pt. 1, p. 18.
—Realejo, Chinandega, Nicaragua.

Specimens.—El Salvador: Depto. San Salvador, San Salvador; 1 male, 2 females; Depto. Cuscatlan, 6.1 km. W. of Cojutepeque along the Interamerican Highway; 1 male, 5 females. Honduras: Depto. Valle, 5.0 km. from El Salvador border along Interamerican Highway, 1 female. Nicaragua: Depto. Matagalpa, Hda. La Cumplida; 1 male. Costa Rica: Prov. Cartago, Turrialba; 3 females; Prov. Heredia, San José de la Montaña, 1520 m. elev.; 1 female; Prov. Limón, Los Diamantes; 1 female.

Reproduction.—The seven females from El Salvador (July 7-9) each contained single embryos which ranged in crown-rump length from 4.5 to 12.4 mm. (the last nearly term, apparently); the two males from this country (July 9) had testes measuring 1.4×1.9 mm. and 2.6×3.6 mm., and showed early spermatogenesis and active spermatogenesis with sperm in the tubules and epididymides, respectively. The female from Honduras (August 16) carried an 11.6 mm. embryo, while the male from Nicaragua (July 16) had small testes, measuring 1.2×2.0 mm., which showed evidence of early spermatogenesis but no sperm in the tubules or epididymides. Of the three females from Costa Rica (July 2-August 9), only two exhibited evidence of reproductive activity: one had a swollen vulva with no other indications, the second had an enlarged uterus which, however, showed no macroscopic embryos. Further evidence of reproductive activity is shown in our collection by young animals taken July 8, in El Salvador,

and July 27 and August 9, in Costa Rica. Felten (1956a) records pregnant females of this species in El Salvador from November through March and from July through September, and females with young from about the same months. Reproductively active males he reports from January, May and June and August through November. Bloedel (1955) reports a pregnant female *Glossophaga* from Panamá in February. Although these data might indicate a two-season breeding cycle, it seems more likely that these tropical bats continue to be reproductively active, at least as a species, throughout the year in Central America.

Food.—Fruit "pulp" and seeds of a number of different kinds of plants were present to some extent in the digestive tract of every *Glossophaga*. No pollen was found in any individual. Eight of the specimens, including representatives from all four countries in which this species was collected, had insect remains in their digestive tracts. In two cases the insect parts made up the bulk of the contents of the tract. The insects had been finely chewed but lepidopteran scales were readily recognizable, as well as portions of the wings of Diptera and Hymenoptera. There were also unidentifiable legs, antennae, setae, tracheae and mandibles. In this regard, it is of interest that Felten (1956a) found that captive *Glossophaga* in El Salvador preferred insects to honey-water or ripe banana. However, the specimen from Los Diamantes, Costa Rica, was captured at a bunch of ripe bananas with the ends cut off, which had been hung out for the purpose of attracting bats. During one evening several of these bats were observed to come, one bat at a time, and hang upside down, with wings folded, from the side of the fruit so as to reach the cut ends. An examination of the bananas in the morning showed cup-like excavations in the cut ends where the bats had rasped out the pulp with their tongues.

As might be expected, those bats netted early in the evening or taken from roosts late in the day had little food in their digestive tracts, whereas those netted later in the night had food in their stomachs and the animals taken in the morning had food material in the stomachs and intestines.

Parasites.—Only one *Glossophaga*, a specimen from Turrialba, Costa Rica, yielded a batfly: one specimen of *Trichobius uniformis* Curran (Streblidae) was found on this animal. In addition, an animal from Turrialba had several nematodes (*Capillaria* sp.) in the stomach and in the peritoneal cavity; a second animal, from San José de la Montaña, had a large number of unidentifiable nematodes in the small intestine.

Remarks.—This species was captured in the greatest variety of day roosts and habitats, as compared with the other species covered in this paper. *Glossophaga* were found in culverts (5-6 individuals) beneath the highway (El Salvador, Honduras), in the subcellar (colony of 30-50 individuals) of the main building of the I.I.C.A. (Costa Rica), in the eaves-attic (colony of several hundred individuals—apparently all the same species) of La Hulera (Costa Rica) and in a small, shallow cave (4 or 5 individuals; San José de la Montaña, Costa Rica). They were netted over a stream (Nicaragua), in a small banana plot (El Salvador) and at banana bait in a carport (Los Diamantes, Costa Rica). General habitats ranged from dry tropical forest at sea level in Honduras to Caribbean lowlands tropical wet forest and low montane wet forests (1520 m.) in Costa Rica.

Measurements.—Forearm, (two males) 32.8, 35.3; (14 females, average and range) 35.6 (34.1-38.0).

Subfamily Carollinae

***Carollia perspicillata azteca* Saussure**

Carollia azteca Saussure, 1860, Rev. Mag. Zool., ser. 2, 12:480.—Type locality subsequently fixed as Pérez, Veracruz, Mexico, by Dalquest (Occ. Pap. Mus. Zool., La. State U., No. 23, p. 2, 1950).

Specimens.—Nicaragua: Depto. Matagalpa, Hda. La Cumplida; 1 male. Costa Rica: Prov. Cartago, Turrialba; 1 female; Prov. Puntarenas, Golfito; 2 males.

Reproduction.—The female from Costa Rica carried an embryo, 13.9 mm. in crown-rump length. The male from Nicaragua had scrotal testes, measuring 3.8×6.8 mm., which showed active spermatogenesis with sperm in the tubules and epididymides. The males from Costa Rica had inguinal testes which measured 2.1×3.5 mm. and 4.6×7.5 mm. and showed early spermatogenesis with no sperm present in tubules or epididymides and active spermatogenesis with sperm in tubules and epididymides, respectively.

Of 28 females of this species taken in El Salvador in the months of October, November, December and March, Felten (1956a) found none pregnant. He records reproductively active males from November and April, and young animals in October and April. Enders (1935) mentions a pregnant female *Carollia perspicillata* from Panamá in March. It is possible that this species may breed all year round, as a species, as Bloedel (1955) suggested, but available evidence does not yet make this certain.

Food.—The digestive tracts of all four speci-

mens contained several types of fruit pulp, seeds and vegetable fibers.

Parasites.—Single batflies, *Trichobius dugesii* Townsend (= *blandus* Curran) (Streblidae) were taken from the specimen from Nicaragua and one of the animals from Costa Rica. A mass of unidentifiable nematodes was found in the mesentery of one bat from Costa Rica, and a single unidentified worm was taken from the small intestine of another from the same country.

Remarks.—The two specimens from Golfito, Costa Rica, were captured by Fred Robinson in banana leaves, along with the specimen of *Thyroptera tricolor* mentioned below.

Measurements.—(Measurements of the specimens from Nicaragua precede those of specimens from Costa Rica; the Golfito males are listed last). Forearm, 43.7, 43.2, 43.1, 41.8; metacarpal III, 43.8, 42.6, 40.0, 40.1; metacarpal IV, 42.9, 41.2, 39.5, 38.7; metacarpal V, 44.3, 43.2, 40.1, 40.1; (cranial measurements for specimen from Nicaragua and female from Costa Rica) greatest length of skull, 24.0, 23.6; condylobasal length, 21.8, 21.2; palatilar length, 10.1, 10.0; interorbital breadth, 6.1, 6.2; postorbital constriction, 5.6, 5.2; mastoid breadth, 12.1, 11.2; length of maxillary tooth row, 8.2, 7.7; maxillary width, including molars, 8.4, 8.2; length of mandibular tooth row, 8.8, 8.5; length of mandible, 15.5, 15.6.

***Carollia subrufa* (Hahn)**

Hemiderma subrufum Hahn, 1905, Proc. Biol. Soc. Wash., 18:247—Santa Efigenia, an hacienda 8 miles NW of Tepanatepec, near west coast of Oaxaca, Mexico.

Specimens.—El Salvador: Depto. San Salvador, San Salvador; 1 male; Depto. Cuscatlan, near Cojutepeque; 1 male.

Reproduction.—Both males had scrotal testes which showed late stages of spermatogenesis, with many interstitial cells and few sperms in the tubules and epididymides. The testes measured 2.0×3.6 and 3.2×5.2 mm., respectively. Felten (1956a) records pregnant females, in El Salvador, in February, March and October; no pregnancies in females from September, November and December. He took reproductively active males in January, March, August and December; found no activity in males from February and September through November. Young animals he found in April, September and October.

Food.—Several types and colors of fruit pulp were taken from the digestive tracts of both specimens, along with bat hairs. A small stalked inflorescence was also found in the small intes-

tine of one, and a segment of an insect leg in the tract of the other.

Parasites.—One of the bats had several unidentifiable nematodes in the small intestine.

Remarks.—Although Felten (1956a) regards *Carollia subrufa* as a subspecies of *C. castanea* H. Allen, these two forms are readily distinguishable on the basis of external, cranial and dental characters, and should be considered as distinct species.

Measurements.—Forearm 38.6, 38.6; metacarpal III, 38.0, 37.4; metacarpal IV, 36.6, 36.3; metacarpal V, 38.1, 38.1; greatest length of skull, 21.7, 21.5; condylobasal length, 19.7, 19.5; palatal length, 9.2, 9.1; interorbital breadth, 5.9, 5.8; postorbital constriction, 5.2, 5.2; mastoid breadth, 10.6, 10.7; length of maxillary tooth row, 7.1, 6.8; maxillary width, including molars, 7.7, 8.0; length of mandibular tooth row, 7.7, 7.6; length of mandible, 13.8, 14.0.

Subfamily Sturnirinae

Sturnira lilium parvidens Goldman

Sturnira lilium parvidens Goldman, 1917, Proc. Biol. Soc. Wash., 30:116.—Papayo, about 25 mi. NW of Acapulco, Guerrero, Mexico.

Specimens.—El Salvador: Depto. San Salvador, San Salvador; 1 male, 2 females. Nicaragua: Depto. Matagalpa, Hda. La Cumplida; 1 female.

Reproduction.—Signs of reproductive activity were present in all four specimens: the male (July 4) had greatly enlarged and scrotal testes (6.2×7.4 mm.), showing late spermatogenesis with sperms in the tubules and epididymides; two females, one from El Salvador (July 5) and the one from Nicaragua (July 13), had enlarged uteri and well developed mammae, indicating fairly recent parturition and lactation; the second female from El Salvador (July 8) had a moderately enlarged uterus and rather prominent mammae, possibly indicating early stages of pregnancy. No macroscopic embryos were found in any female. Felten (1956b) records of lactating female of this species in El Salvador in June.

Food.—All four specimens were presumably captured immediately after emerging from diurnal roosts, since none of them had any food in the digestive tract other than small amounts of fruit pulp in the lower colon. The Nicaragua specimens had a completely empty tract. Two specimens (male and female from El Salvador) were taken in a net at about 10:45 p.m., immediately after a heavy downpour which had started at dusk. The other two were extracted from nets in the morning.

Parasites.—No parasites were found on or in any of the specimens.

Remarks.—The specimen from Nicaragua marks the first record of this bat from that country.

Measurements.—(El Salvador male, two females and Nicaragua female, respectively) Forearm, 41.3, 38.8, 38.9, 38.4; metacarpal III, 39.5, 38.6, 38.7, 37.6; metacarpal IV, 40.1, 38.4, 38.3, 38.0; metacarpal V, 40.5, 39.1, 39.6, 39.1; greatest length of skull, 22.2, 20.7, 22.1, 21.1; condylobasal length, 19.7, 18.4, 19.5, 19.0; palatal length, 9.5, 9.1, 9.5, 9.0; interorbital breadth, 6.0, 5.3, 5.8, 5.9; postorbital constriction, 5.6, 5.1, 5.5, 5.6; zygomatic breadth, 13.1, 12.1, 13.1, 12.8; mastoid breadth, 11.7, 10.8, 11.9, 10.8; length of maxillary tooth row, 6.6, 6.3, 6.2, 6.3; maxillary width, including molars, 8.1, 7.4, 7.7, 7.5; length of mandibular tooth row, 7.4, 7.0, 7.2, 7.2; length of mandible, 14.3, 13.5, 13.9, 13.6.

Sturnira ludovici Anthony

Sturnira ludovici Anthony, 1924, Amer. Mus. Nov., no. 139:8.—Near Gualea, northwestern Ecuador, elevation about 4000 ft.

Sturnira hondurensis Goodwin, 1940, Amer. Mus. Nov., no. 1075:1-2.—La Cruz Grande, Dept. of La Paz, Honduras, elevation about 3000 ft.

Specimens.—Costa Rica: Prov. Cartago, Volcán Turrialba, elevation 2820 m.; 2 males (1 imm.), 1 female.

Reproduction.—The immature male had abdominal testes which measured 1.9×3.0 mm., but showed signs of beginning spermatogenesis, with many interstitial cells and no sperms present. The adult male had scrotal testes, measuring 3.7×4.2 mm., and enlarged epididymides; the testes showed active spermatogenesis, with sperms in the tubules and some in the epididymides, and numerous interstitial cells. The female showed no macroscopic signs of reproductive activity. (All three specimens were captured July 24).

Food.—As with the *S. lilium* discussed above, these animals must have been captured shortly after emergence from their daytime roosts and prior to much feeding. Two of them had only small amounts of fruit pulp in the colon and the third had also a small amount of the same material in its stomach. Additional evidence of their having been captured early in the evening was shown by the extremely torpid condition of these animals when they were extracted from the net in the morning. The cold night had reduced their

activity to the point where blowflies had laid eggs in the fur of one, presumably early in the morning. All three bats again became quite active during the trip back to the laboratory.

Parasites.—All three specimens of *Sturnira ludovici* were heavily infested with batflies, five of which were collected. These proved to be *Pterellipsis proxima* Seguy (Streblidae).

Remarks.—This species has been recorded previously from Costa Rica by two specimens from Agua Buena, Prov. Puntarenas, near the Panamá border.

Measurements.—(1 male, 1 female, respectively) forearm, 43.9, 42.9; metacarpal III, 42.4, 41.4; metacarpal IV, 42.5, 41.4; metacarpal V, 44.2, 43.0; greatest length of skull, 22.4, 22.4; condylobasal length, 20.4, 20.0; palatal length, 9.4, 9.0; interorbital breadth, 6.4, 6.0; postorbital constriction, 6.1, 5.7; zygomatic breadth, 13.0, 12.7; mastoid breadth, 11.0, 11.3; length of maxillary tooth row, 6.4, 6.4; maxillary width, including molars, 7.6, 7.8; length of mandibular tooth row, 7.4, 7.1; length of mandible, 14.5, 14.1.

Subfamily Stenoderminae

***Vampyrops helleri* Peters**

Vampyrops helleri Peters, 1866, Monatsb. Preuss. Akad. Wiss. Berlin, 1866:392.—“Mexico.”

Specimens.—Costa Rica: Prov. Cartago, Turrialba; 1 female.

Reproduction.—This animal showed no macroscopic indication of reproductive activity (August 11).

Food.—Small amounts of fruit pulp were present in all parts of the digestive tract.

Parasites.—No parasites, external or internal, were found on this animal.

Remarks.—This species has been recorded previously in Costa Rica from two localities: Prov. Cartago, Guayalo (not far from Turrialba), by two specimens (Sanborn, 1955); Prov. Limón, Jiménez, by 1 specimen (Allen, 1893, and Goodwin, 1946). It is otherwise known in North America by but five additional specimens, taken in México, Honduras and Panamá (Sanborn, 1955).

For use of the generic name *Vampyrops* Peters, 1865, in preference to *Platyrrhinus* Sausure, 1860, see De la Torre and Starrett (1959).

Measurements.—Forearm, 38.8; metacarpal III, 38.5; metacarpal IV, 38.5, metacarpal V, 39.0; greatest length of skull, 22.8; condylobasal length, 20.4; palatal length, 9.8; interorbital breadth, 6.2; postorbital constriction, 5.7; zygomatic breadth, 12.1; mastoid breadth, 10.8;

length of maxillary tooth row, 7.9; maxillary width, including molars, 8.9; length of mandibular tooth row, 8.7; length of mandible, 15.5.

***Vampyressa thyone* Thomas**

Vampyressa thyone Thomas, 1909, Ann. Mag. Nat. Hist., (8) 4:231.—Chimbo, near Guayaquil, Ecuador.

Vampyressa minuta Miller, 1912, Proc. U.S. Nat. Mus., 42:25.—Cabima, Panamá.

Specimens.—Nicaragua: Depto. Matagalpa, Hda. La Cumplida, 670 m. elevation; 1 female.

Reproduction.—The uterus of this animal (July 14) contained an embryo of 11.8 mm., crown-rump length (in shrivelled condition; probably closer to 13.5 mm. in actual length).

Food.—A tiny amount of pulp was found in this bat's small intestine.

Parasites.—No parasites were found in or on this specimen.

Remarks.—We concur with Hershkovitz (1949) in placing *V. minuta* Miller in synonymy with *V. thyone* Thomas. The Nicaragua specimen compares favorably in measurements with those listed by Goodwin (1946) for the type of *V. minuta*, from Cabima, Panamá, and for a specimen from Agua Buena, Costa Rica. We also find the specimen from Nicaragua indistinguishable in salient characters, including measurements, from three specimens from Peru in the Chicago Natural History Museum collection.

This specimen marks the first record of *Vampyressa thyone* from Nicaragua, and extends the northern limit of range for the species to this country. The previous northernmost record was provided by two specimens from Agua Buena, Prov. Puntarenas, Costa Rica (Goodwin, 1946).

Measurements.—Forearm, 31.4; metacarpal III, 30.3; metacarpal IV, 29.3; metacarpal V, 30.9; greatest length of skull, 18.4; condylobasal length, 16.6; palatal length, 8.6; interorbital breadth, 4.9; zygomatic breadth, 10.5; mastoid breadth, 9.0; length of maxillary tooth row, 6.0; length of mandibular tooth row, 6.4; length of mandible, 11.5.

***Artibeus jamaicensis jamaicensis* Leach**

Artibeus jamaicensis Leach, 1821, Trans. Linn. Soc. London, 13:75.—Jamaica.

Specimens.—Nicaragua: Depto. Matagalpa, Hda. La Cumplida; 1 male. Costa Rica: Prov. Cartago, Turrialba; 1 male.

Reproduction.—The animal from Nicaragua (July 17) had scrotal testes which measured 3.5 × 5.0 mm. and showed late spermatogenesis with numerous sperms in the tubules and some

in the epididymides. The male from Costa Rica (July 24) had scrotal testes, 3.8×5.3 mm., which showed late spermatogenesis, with numerous sperms in the tubules and epididymides and few interstitial cells. Felten (1956b) records breeding males in October and lactating females in March, in El Salvador.

Food.—The intestines of these animals contained fruit pulp, plant fibers and bat hairs (presumably from the animals themselves). The animal from Costa Rica also had an ant (Formicidae: Ponerinae) embedded in a reddish amber-like substance in its intestine.

Parasites.—The only parasite found was an unidentifiable roundworm which was taken from the small intestine.

Measurements.—Forearm (specimens from Nicaragua and Costa Rica, respectively), 60.7, 64.7; (specimen from Nicaragua) metacarpal III, 57.0; digit III, first phalanx, 17.6; digit III, second phalanx, 30.7; metacarpal IV, 56.0; digit IV, first phalanx, 15.7; metacarpal V, 58.8; digit V, first phalanx, 11.5; postorbital constriction, 7.9; zygomatic breadth, 18.7; percentage postorbital constriction/zygomatic breadth, 42.3 (specimen from Costa Rica), 38.9.

Artibeus lituratus palmarum J. A. Allen & Chapman.

Artibeus palmarum J. A. Allen & Chapman, 1897, Bull. Amer. Mus. Nat. Hist., 9:16.—Port of Spain, Trinidad.

Specimens.—El Salvador: Depto. San Salvador, San Salvador; 1 male (young adult), 1 female. Nicaragua: Depto. Matagalpa, Hda. La Cumplida; 1 male (imm.). Costa Rica: Prov. Cartago, Turrialba; 2 females (1 imm.).

Reproduction.—All three females showed signs of reproductive activity: that from El Salvador (July 8) had greatly developed mammae and an enlarged uterus, indicating recent parturition and lactation still in progress; one from Costa Rica (July 23) contained a 39 mm. (crown-rump length) male embryo which, judging from the development of the maternal mammae, was near term; the second from Costa Rica (July 22) had a swollen vulva and slightly enlarged uterus. The young adult male from El Salvador (July 6) had scrotal testes, 3.9×5.0 mm., showing active spermatogenesis, with some sperm in the tubules and a few in the epididymides, and few interstitial cells; the immature male from Nicaragua also had scrotal testes, 3.5×4.8 mm., but which showed only some spermatogenic activity with no sperms present, and many interstitial cells visible. Bloedel (1955) mentions a female that gave birth in March in Panamá: Hall & Jackson (1953) record a pregnant female in May, also

in Panamá; Felten (1956b) mentions reproductive activity in males in October and November, a female with young in April, in El Salvador. Year round reproductive activity may be indicated for *Artibeus lituratus*, as a species, in Middle America.

Food.—Fruit pulp of several colors and types, plant fibers and bat hairs occurred in varying amounts in the digestive tracts of these bats. In addition, a few scattered insect remains were found in the intestines of two of the animals.

Parasites.—The only parasites found were bat flies, *Paratrachobius longicrus* Ribeiro (Streblidae) and several tapeworms, *Vampirolepis* sp. (Hymenolepididae), all of which were taken from the male from El Salvador.

Measurements.—(Young adult male from El Salvador, adult females from El Salvador, Costa Rica, respectively) Forearm, 66.0, 70.2, 72.3; (young adult male, female from Costa Rica) metacarpal III, 62.6, 70.4; digit III, first phalanx, 21.2, 23.9; digit III, second phalanx, 34.3, 37.5; metacarpal IV, 62.6, 66.6; digit IV, first phalanx, 17.5, 19.9; metacarpal V, 64.9, 72.8; digit V, phalanx, 14.0, 15.8; greatest length of skull, 27.6, 31.5; condylobasal length, 24.5, 28.0; palatal length, 12.7, 15.1; interorbital breadth 7.4, 7.8; postorbital constriction, 6.0, 6.6; zygomatic breadth, 16.0, 19.6; mastoid breadth, 14.2, 17.0; length of maxillary tooth row, 9.8, 11.0; maxillary width, including molars, 11.5, 13.9; length of mandibular tooth row, 10.9, 12.3; length of mandible, 18.8, 21.6; percentage postorbital constriction/zygomatic breadth, 37.5, 33.7.

Family THYROPTERIDAE

Thyroptera tricolor albigula G. M. Allen

Thyroptera tricolor albigula G.M. Allen, 1923, Proc. New Eng. Zool. Club., 9:1.—Gutiérrez, Chiriquí, Panamá.

Specimen.—Costa Rica: Prov. Puntarenas, Golfito; 1 male.

Reproduction.—The testes were small and were not sectioned (August 8).

Food.—Small amounts of insect remains were found in the stomach and colon of this specimen.

Parasites.—No parasites were found on or in this animal.

Remarks.—This specimen marks the second record for the species in Costa Rica and the fourth north of Panamá.

Measurements.—Forearm, 34.3.

Family VESPERTILIONIDAE

Subfamily Vespertilioninae

Myotis nigricans nigricans (Schinz)

Vesp (ertilio) nigricans Schinz, 1821, Das Tierreich, 1:179.—Fazenda de Aga, near Rio Iritiba, Espírito Santo, southeastern Brazil.

Specimens.—El Salvador: Depto. La Libertad, 2.7 mi. E of Colón; 2 males. Costa Rica: Prov. Alajuela, Volcán Poás, elevation approximately 1980 m.; 1 male.

Reproduction.—Reproductive activity was not indicated for any of these specimens. The female (July 4) showed no macroscopic signs of activity; the males both had external testes which were not descended into the scrotal areas, and the testes of both (El Salvador, July 4; Costa Rica, August 6) were small (2.0×3.3 , 3.0×4.0 mm.) and showed little spermatogenic activity with no sperm present and numerous interstitial cells visible.

Food.—The digestive tracts of all three specimens contained the finely chewed remains of insects.

Parasites.—Two males of a batfly, *Basilis* sp. (Nycteribidae) were taken from one of the bats from El Salvador.

Measurements.—Forearm (male from Costa Rica last), 34.7, 35.6, 36.7.

Eptesicus brasiliensis propinquus (Peters)

Vesperus propinquus Peters, 1872, Monatsb. Preuss. Akad. Wiss. Berlin, 1872: 262.—Santa Isabel, Peten, Guatemala.

Specimens.—Costa Rica: Prov. Cartago, Turrialba; 1 male, 1 female.

Reproduction.—The female (July 28) showed no macroscopic signs of reproductive activity; the male (July 23) had small (2.7×4.7 mm.) scrotal testes which showed little spermatogenic activity with no sperm and numerous interstitial cells.

Food.—The digestive tracts of both specimens were filled with finely chewed remains of insects.

Parasites.—No parasites were found on or in either of the specimens.

Measurements.—(Male first) forearm, 40.1, 42.9; metacarpal III, 38.8, 40.5; metacarpal IV, 38.3, 39.9; metacarpal V, 37.2, 38.9; greatest length of skull, 16.5, —; condylobasal length, 15.6, —; palatilar length, 5.9, 6.1; post-orbital constriction, 3.8, —; zygomatic breadth, 10.8, —; mastoid breadth, 8.5, —; length of maxillary tooth row, 5.9, 6.1; maxillary width, including molars, 6.4, 6.9; length of mandibular tooth row, 6.6, 6.5; length of mandible, 11.7, 12.2.

Family MOLOSSIDAE

Tadarida brasiliensis brasiliensis (I. Geoffroy-Saint Hilaire)

Nyctinomus brasiliensis I. Geoffroy-Saint Hilaire, Ann. Sci. Nat., 1:343.—Curityba, Paraná, Brazil.

Specimens.—Costa Rica: Prov. Heredia, San José de la Montaña, 1520 m. elev.; 1 male, 11 females; Prov. Alajuela, La Cinchona, approx. 1350 m. elev.; 3 males, 1 female.

Reproduction.—The only possible macroscopic indication of reproductive activity in the females (July 27, August 9) was a slight enlargement of the right horn of the uterus in five individuals; the males (July 27, August 9) had small ($1.3-1.6 \times 2.3-3.3$ mm.) inguinal testes which showed no spermatogenesis, no sperms in the tubules or epididymides, and many interstitial cells.

Food.—Small amounts of insect remains were found in the lower digestive tracts of these bats, all of which were taken from roosts during the day.

Parasites.—Mites (indet.) were taken from one of the specimens from La Cinchona.

Remarks.—The specimens from San José de la Montaña were taken from a colony of unknown size under the roof of one of the buildings at the Hogar Bíblico; those from La Cinchona were collected from a colony of several hundred individuals under the loose clapboards on the side of a building.

Measurements.—Forearm, 4 males, av. 43.2 (41.6-44.0); 12 females, av. 44.0 (41.6-45.9).

Molossus major (Kerr)

V (espertilio) mol (ossus) major Kerr, the Animal Kingdom, p. 97.—Martinique, Lesser Antilles.

Specimens.—El Salvador: Depto. San Salvador, San Salvador, I.T.I.C.; 2 males, 2 females.

Reproduction.—The only possible macroscopic indication of activity in the females (July 5) was a slight enlargement of the right horn of the uterus in both specimens; the testes of the male taken July 4 were small (2.3×4.0 mm.), scrotal, and showed active late spermatogenesis with sperms in the tubules and epididymides and relatively large number of medium-sized interstitial cells.

Food.—The stomach of one female was greatly distended with insect remains, the tracts of the other bats were less full of the same material.

Parasites.—No parasites were taken from any of these animals.

Remarks.—These four specimens were shot at dusk over the grounds of the I.T.I.C., San Salvador. Each evening, during our week's stay at the I.T.I.C., from between 6:15 to 6:30 and dark, large numbers of the bats flew low over the institute as they passed in a fairly direct path from southwest (the direction of San Salvador) to northeast. The full condition of the digestive tracts of the animals collected and the low and somewhat slow and erratic flight of the bats as they passed over the institute indicate that they were feeding as they left the roost, and the direct general orientation of flight suggests that they were possibly on their way to night feeding grounds and roosts in the cultivated regions around the city.

The present state of knowledge concerning the genus *Molossus* leaves the matter of relationships between named forms far from clear. Therefore, we are using here the oldest name which was applied to the pygmy form which our specimens represent.

Measurements.—Forearm (1 male, 2 females) 39.1, 38.5, 38.0.

LITERATURE CITED

- ALLEN, JOEL ASAPH
1893. Further notes on Costa Rican mammals, with description of a new species of *Oryzomys*. *Bull. Amer. Mus. Nat. Hist.*, vol. 5, art. 15, pp. 237-240.
- BLOEDEL, PRENTICE
1955. Observations on life histories of Panama bats. *Jour. Mamm.*, vol. 36, no. 2, pp. 233-235.
- ENDERS, ROBERT K.
1935. Mammalian life histories from Barro Colorado Island, Panama. *Bull. Mus. Comp. Zool.*, vol. 78, pp. 285-502.
- FELTEN, HEINZ
1956a. Fledermäuse, Mammalia, Chiroptera) aus El Salvador. Teil 3. *Senck. Biol.*, vol. 37, no. 3/4, pp. 179-212.
- 1956b. Fledermäuse (Mammalia, Chiroptera) aus El Salvador. Teil 4. *Senck. Biol.*, vol. 37, no. 5/6, pp. 341-367.
- FRASER, C. McLEAN
1943a. General account of the scientific work of the *Velero III* in the Eastern Pacific, 1931-41. Part II. Geographical and Biological Associations (Plates 17-128). *Allan Hancock Pacific Expeditions*, vol. 1, no. 2, pp. 49-258.
1943b. General account of the scientific work of the *Velero III* in the Eastern Pacific, 1931-41. Part III. A ten-year list of the *Velero III* collection stations (Charts 1-115). *Allan Hancock Pacific Expeditions*, vol. 1, no. 3, pp. 259-431.
- GOODWIN, GEORGE G.
1946. Mammals of Costa Rica. *Bull. Amer. Mus. Nat. Hist.*, vol. 87, art. 5, pp. 275-473.
- HALL, E. RAYMOND, & WILLIAM B. JACKSON
1953. Seventeen species of bats recorded from Barro Colorado Island, Panama Canal Zone. *Univ. Kans. Publ. Mus. Nat. Hist.*, vol. 5, no. 37, pp. 641-646.
- HERSHKOVITZ, PHILIP
1949. Mammals of northern Colombia. Preliminary report No. 5: Bats (Chiroptera). *Proc. U.S. Natl. Mus.*, vol. 99, no. 3246, pp. 429-454.
- MILLER, GERRIT, S., JR.
1907. The families and genera of bats. *U.S. Natl. Mus. Bull.*, vol. 57, pp. 1-282.
- SANBORN, COLIN C.
1955. Remarks on the bats of the genus *Vampyrus*. *Fieldiana: Zoology*, vol. 37, pp. 403-413.
- THOMAS, OLDFIELD
1913. On some rare Amazonian mammals from the collections of the Para Museum. *Ann. and Mag. Nat. Hist.*, 8th ser., vol. 11, pp. 130-136.
- DE LA TORRE, LUIS, & ANDREW STARRETT
1959. Name changes and nomenclatural stability. *Nat. Hist. Misc.*, no. 167, pp. 1-4.